Installation Manual
MMI-20020994, Rev AA
December 2013

Micro Motion® Fork Viscosity Meters

Direct insertion viscosity meter installation

Micro Motion®

EMERSON™
Process Management

Safety and approval information

This Micro Motion product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EC declaration of conformity for directives that apply to this product. The EC declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions are available on the internet at *www.micromotion.com* or through your local Micro Motion support center.

Information affixed to equipment that complies with the Pressure Equipment Directive can be found on the internet at *www.micromotion.com/documentation*.

For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the transmitter configuration manual. Product data sheets and manuals are available from the Micro Motion web site at *www.micromotion.com/documentation*.

Return policy

Micro Motion procedures must be followed when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Failure to follow Micro Motion procedures will result in your equipment being refused delivery.

Information on return procedures and forms is available on our web support system at *www.micromotion.com*, or by phoning the Micro Motion Customer Service department.

Micro Motion customer service

Email:

- Worldwide: *flow.support@emerson.com*
- Asia-Pacific: *APflow.support@emerson.com*

Telephone:

North and South America		**Europe and Middle East**		**Asia Pacific**	
United States	800-522-6277	U.K.	0870 240 1978	Australia	800 158 727
Canada	+1 303-527-5200	The Netherlands	+31 (0) 318 495 555	New Zealand	099 128 804
Mexico	+41 (0) 41 7686 111	France	0800 917 901	India	800 440 1468
Argentina	+54 11 4837 7000	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3413 8000	Italy	8008 77334	China	+86 21 2892 9000
Venezuela	+58 26 1731 3446	Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
		Russia/CIS	+7 495 981 9811	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudia Arabia	800 844 9564		
		UAE	800 0444 0684		

Contents

1 Planning

Topics covered in this chapter:

1.1 Installation checklist

☐ Verify the contents of the product shipment to confirm you have all parts and information necessary for the installation.

☐ Verify the meter calibration range and boundary corresponds to the planned installation. A calibration mismatch can cause measurement error, and will need to be corrected.

☐ Make sure that all electrical safety requirements are met for the environment in which the meter will be installed.

☐ Make sure that the local ambient and process temperatures and process pressure are within the limits of the meter.

☐ Make sure that the hazardous area specified on the approval tag is suitable for the environment in which the meter will be installed.

☐ Make sure that you will have adequate access to the meter for verification and maintenance.

☐ Verify that you have all equipment necessary for your installation. Depending on your application, you may be required to install additional parts for optimal performance of the meter.

☐ If your meter will be wired to a remote-mount 2700 FOUNDATION fieldbus™ transmitter:

- Refer to the instructions in this manual for preparing the 4-wire cable and wiring to the processor connections.
- Refer to the instructions in the transmitter installation manual for mounting and wiring the 2700 FOUNDATION fieldbus™ transmitter. See *Micro Motion Model 1700 and Model 2700 Transmitters: Installation Manual*.
- Consider the maximum cable length between the meter and transmitter. The maximum recommended distance between the two devices is 1000 ft (300 m). Micro Motion recommends using Micro Motion cable.

1.2 Best practices

The following information can help you get the most from your meter.

- Handle the meter with care. Follow local practices for lifting or moving the meter.
- Perform a Known Density Verification (KDV) check of the meter prior to installing the meter in your system.
- For the PFA-coated tines, always fit the protective cover over the tines when the meter is not in use. The tine coating is not resistant to impact damage.
- Always store and transport the meter in its original packaging. For the long-stem meters, be sure to include the transit cover secured by the grub screws.
- Do not use liquids incompatible with the materials of construction.
- Do not expose the meter to excessive vibration (greater than 0.5 g continuously). Vibration levels in excess of 0.5 g can affect the meter accuracy.
- For optimal performance of the meter, ensure the operating conditions correspond to the meter calibration range and boundary.
- Ensure all piping connections conform to the local and national regulations and codes of practice.
- Ensure the transmitter housing cover is tightened properly after wiring to maintain ingress protection and hazardous area approvals.
- Ensure the meter and associated pipework are pressure tested to 1½ times the maximum operating pressure after installation.
- Thermally insulate the meter and the inlet and bypass-loop pipeline to maintain stable temperatures.

1.3 Power requirements

Following are the DC power requirements to operate the meter:

- 24 VDC, 0.65 W typical, 1.1 W maximum
- Minimum recommended voltage: 21.6 VDC with 1000 ft of 24 AWG (300 m of 0.20 mm^2) power-supply cable
- At startup, power source must provide a minimum of 0.5 A of short-term current at a minimum of 19.6 V at the power input terminals.

Power cable recommendations for explosion-proof/flameproof meters

Figure 1-1: Minimum wire gauge (AWG per feet)

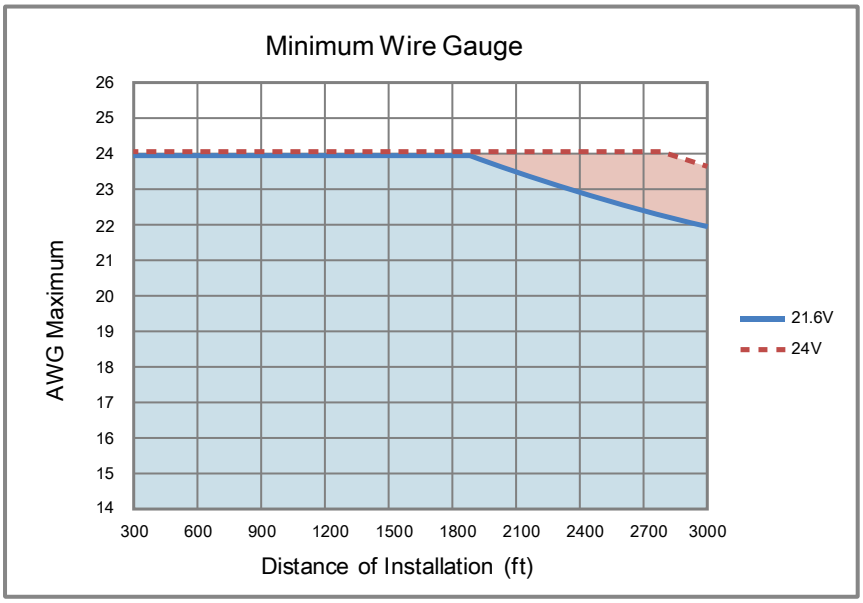
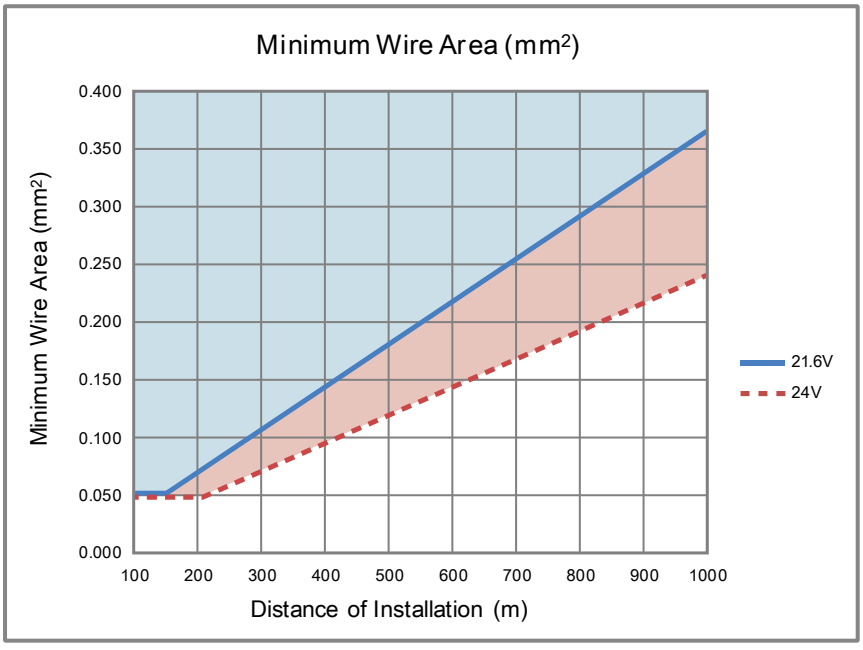


Figure 1-2: Minimum wire area (mm^2 per meter)



1.4 Other installation considerations

A variety of external factors exist that affect the ability of the meter to operate successfully. To ensure that your system works correctly, consider the effects of these factors when designing your installation.

1.4.1 Calibration boundaries

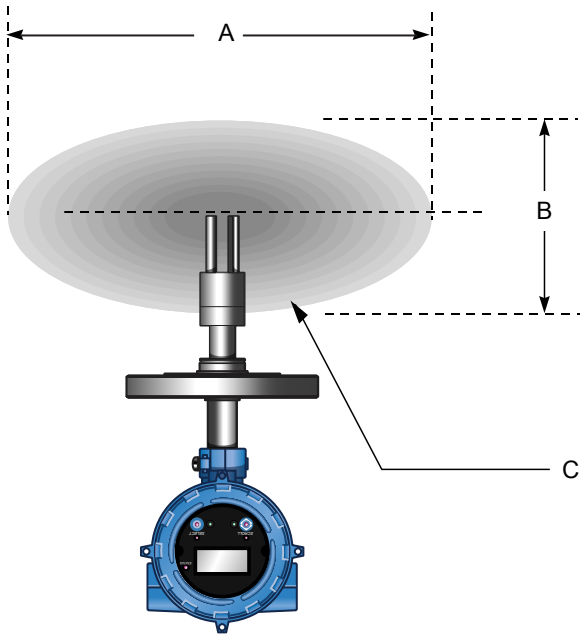
Important

Micro Motion calibrates all meters at the factory according to the sensor calibration range selected at point of purchase. The factory calibration process takes into account the potential boundary effect of the planned installation. At point of installation, confirm that the meter calibration range and boundary matches the planned installation to ensure optimum performance of the meter. If the meter calibration does not match the planned installation, measurement error may occur and you will need to perform an onsite calibration.

The boundary effect of an installation refers to the sensitive, or effective, region of the meter sensing device being interrupted by the boundary of the pipe walls. This effect can vary based on the type of installation or the size of the pipeline diameter. Considering this effect when calibrating the meter is important because the direct insertion meter can only measure the properties of the fluid that are within the region that the meter is sensitive.

The vibration of the fork meter tines creates an effective measurement region that is shaped as an ovoid centered on the tips of the tines. The long axis of the ovoid is aligned with the direction that the tines are vibrating. The meter sensor is insensitive to any fluid properties outside of this region, and progressively more sensitive to the fluid properties the closer the fluid is to the meter tines (see *Figure 1-3*).

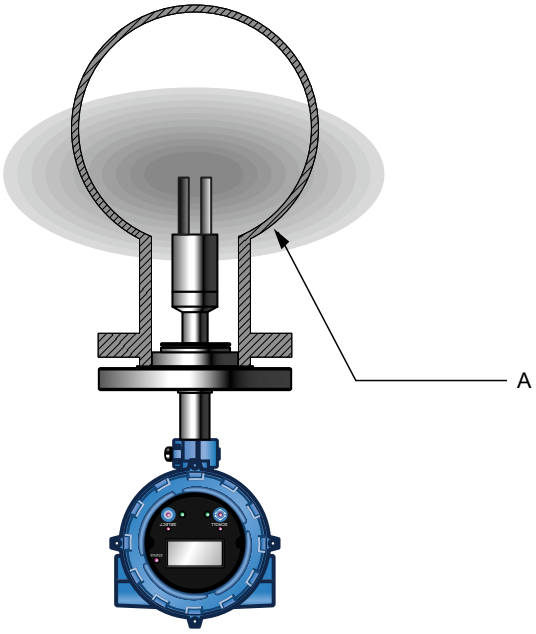
Figure 1-3: Region of measurement boundary or sensitivity



A. Long axis
B. Short axis
C. Sensitive, or effective, region

When installing the meter, if part of this effective region or volume is interfered with because of the pipework or fittings a boundary effect exists (see *Figure 1-4*).

Figure 1-4: Example of pipeline installation (with boundary effect)



A. Pipe walls interrupt effective region of meter sensitivity

1.4.2 Flow rate considerations

You must maintain flow rates and velocities to be relatively constant within the limits specified for the meter. The fluid flow provides a steady heat flow into the meter installation, and the flow rate influences the self-cleaning of the meter tines and the dissipation of bubbles and solid contaminants around the meter.

If you install the meter in a bypass configuration (such as in a free-stream installation in a 4-inch diameter horizontal bypass, or a flow-through chamber): you can maintain flow by using a pressure drop, pitot scoop, or a sample pump. When using a sample pump, place the pump upstream from the meter.

1.4.3 Entrained gas considerations

Entrained gas, or gas pockets, can disrupt the measurement of a fluid. A brief disruption in the signal caused by transient gas pockets can be corrected in the meter configuration, but you must avoid more frequent disruptions or serious gas entrainment to ensure accurate and reliable fluid measurement.

To minimize the possibility of entrained gas:

- Keep pipe lines full of fluid at all times.
- Vent any gas prior to the meter installation location.
- Avoid sudden pressure drops or temperature changes which may cause dissolved gases to break out of the fluid.

- Maintain a back pressure on the system sufficient to prevent gas break out.
- Maintain flow velocity at the sensor within the specified limits.

1.4.4 Solids measurement considerations

Consider the following to avoid issues related to solids contamination:

- Avoid sudden changes of the fluid velocity that may cause sedimentation.
- Install the meter far enough downstream from any pipework configuration that may cause centrifuging of solids (such as at a pipe bend).
- Maintain flow velocity at the meter installation that is within the specified limits.
- Use filtration in your process, if necessary.

1.4.5 Thermal effects considerations

For high viscosity fluids, you should minimize any temperature gradients in the fluid, and in the piping and fittings immediately upstream and downstream of the meter. Minimizing temperature gradients reduces the effect of viscosity changes. We recommend the following to reduce the thermal effects to your meter installation:

- Always insulate the meter and surrounding pipework thoroughly.
  - Insulation must be at least 1 inch (25 mm) of rockwool, preferably 2 inches (50 mm), or use an equivalent insulating heat jacket.
  - Insulation must be enclosed in a sealed protective casing to prevent moisture ingress, air circulation, and crushing of the insulation.
  - For flow-through chamber installations, Micro Motion provides a special insulation jacket because of the opportunity for low volumetric flow rates (hence, low heat flow) and increased vulnerability to temperature effects.
- Avoid direct heating or cooling of the meter and associated pipe work upstream and downstream that is likely to create temperature gradients.
- If it is necessary to provide protection against cooling because of loss of flow, you can apply electrical trace heating. This type of heating must be thermostatically controlled, and the thermostat must be set to operate below the minimum operating temperature of the system.

1.5 Recommended installations for short-stem meters

Micro Motion recommends three standard installations for the short-stem meter to alleviate any need for onsite calibration. All meters are factory calibrated for these types of installations and take into consideration the potential boundary effect of each installation.

Table 1-1 highlights these different installations according to specific conditions or requirements that may exist for your process environment.

Table 1-1: Standard installation types: short-stem meters

Installation type:	Free stream	T-Piece	Flow-through chamber
Meter placement	Meter tines are inserted directly into the main fluid flow. The meter must always be installed horizontally and with the tines oriented to allow flow through or between the gap of the tines.	Meter tines are contained in a side pocket off the main flow. The meter must always be installed horizontally and with the tines oriented to allow flow through or between the gap of the tines.	Meter tines are contained in a flow-through chamber in which fluid is circulated from the main flow.
Flow rate	0.3 to 0.5 m/s (at the meter)	0.5 to 3 m/s (at main pipe wall)	10 to 30 l/min
Viscosity	Up to 500 cP	Up to 100 cP (250 cP in some cases)	Up to 500 cP
Temperature	–50 °C to 200 °C (–58 °F to 392 °F)	–50 °C to 200 °C (–58 °F to 392 °F)	–50 °C to 200 °C (–58 °F to 392 °F)
Main flow pipe size	• Horizontal pipe: minimum diameter, 100 mm (4 inch) • Vertical pipe: minimum diameter, 150 mm (6 inch)	Minimum diameter, 100 mm (4 inch)	Suitable for all sizes, if mounted in a bypass (slipstream) configuration
Advantages	• Simple installation in large bore pipes • Ideal for clean fluids and non-waxing oils • Suitable for line viscosity measurement and simple referrals	• Simple installation in large bore pipes • Ideal for clean fluids and non-waxing oils • Suitable for line viscosity measurement and simple referrals	• Adaptable installation to any diameter main pipe and for tank applications • Ideal for flow and temperature conditioning • Suitable for complex referrals and for use with heat exchangers • Suitable for step changes in viscosity • Fast response • Ideal for analyzer cubicles

Table 1-1: Standard installation types: short-stem meters ***(continued)***

Installation type:	Free stream	T-Piece	Flow-through chamber
Recommendations	Do not use with: • Dirty fluids • Low or unstable flow rates • Where step changes in viscosity can occur • For small bore pipes	Do not use with: • Dirty fluids • Low or unstable flow rates • Where step changes in viscosity can occur • For small bore pipes • Where temperature effects are significant	• Do not use with uncontrolled flow rates. • Careful system design is required to ensure representative measurement. • Frequently requires the use of a pump.

1.6 Perform a meter check (pre-installation)

Micro Motion® recommends that you perform a check of the meter prior to installation. This check confirms that no damage occurred to the meter during shipment.

1. Remove the meter from the box.

   ⚠ CAUTION!

   Handle the meter with care. Follow local practices for lifting or moving the meter.

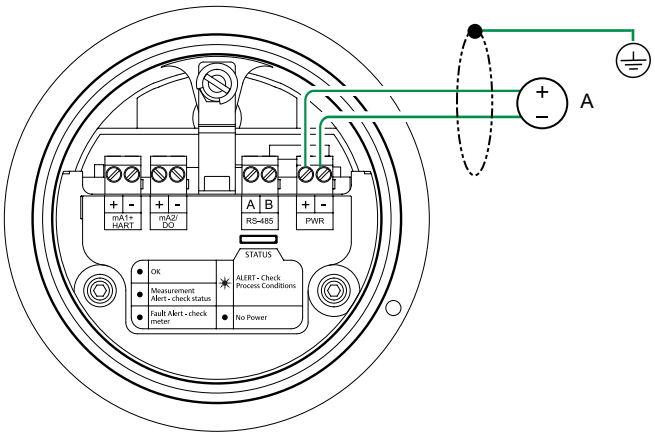
2. Visually inspect the meter for any physical damage.

   If you notice any physical damage to the meter, immediately contact Micro Motion Customer Support at *flow.support@emerson.com*.

3. Connect and power up the meter.

   You must remove the back transmitter housing cover to access the PWR terminals.

Figure 1-5: Power supply wiring terminals



A. 24 VDC

4. Perform a Known Density Verification (KDV) check.

   The Known Density Verification procedure is used to verify that the meter's current operation matches the factory calibration. If the meter passes the test, then it has not drifted or changed since its factory calibration.

   For more information on performing a KDV check, see the configuration and use manual that shipped with the product.

2 Mounting

Topics covered in this chapter:

2.1 Mount in free-stream application (flanged fitting)

Prerequisites

Free-stream (flanged) installations are recommended for processes with the following conditions:

Flow	0.3 to 0.5 m/s (at the meter)
Viscosity	0.5 to 12,500 cP
Temperature	-50 °C to 200 °C (–58 °F to 392 °F)
	-40 °C to 200 °C (-40 °F to 392 °F) in hazardous areas

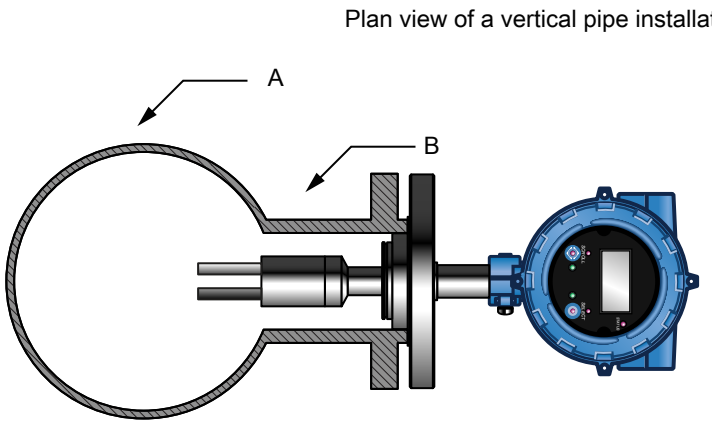
Procedure

See *Figure 2-1* for information on installing the meter (with a flanged fitting) in a free-stream application.

Important

You must always install the meter horizontally and oriented to allow flow in the gap between the tines, irrespective of the pipeline orientation (horizontal or vertical). This position helps to prevent the trapping of bubbles or solids on the meter – allowing the solids to sink and the bubbles to rise.

Figure 2-1: Free-stream (flanged fitting) meter installation



A. 4-inch pipe for horizontal installations; 6-inch (152 mm) pipe for vertical installations

B. Size the recess mount so that the meter tines are inserted fully into the liquid [approximately 2.75 in (70 mm)].

2.2 Mount in free-stream application (weldolet fitting)

The weldolet for free-stream installations has a 1.5-inch taper lock fitting and is supplied to be welded on 4-inch, 6-inch, 8-inch or 10-inch pipelines. A weldolet installation ensures that the tines of the meter are oriented correctly and are fully inserted into the fluid stream.

Prerequisites

- Free-stream (weldolet) installations are recommended for processes with the following conditions:

Flow	0.3 to 0.5 m/s (at the meter)
Viscosity	0.5 to 12,500 cP
Temperature	–50 °C to 200 °C (–58 °F to 392 °F)
	–40 °C to 200 °C (–40 °F to 392 °F) in hazardous areas

Note

If temperature variations are a critical factor in your process, the reduced thermal mass of the taper-lock fitting of the weldolet can track changes in temperature more efficiently.

- Before fitting the weldolet, you must bore a 2.1 in (52.5 mm) diameter opening in the pipeline to accept the meter. You must weld the weldolet to the pipeline concentrically with the pre-bored hole.

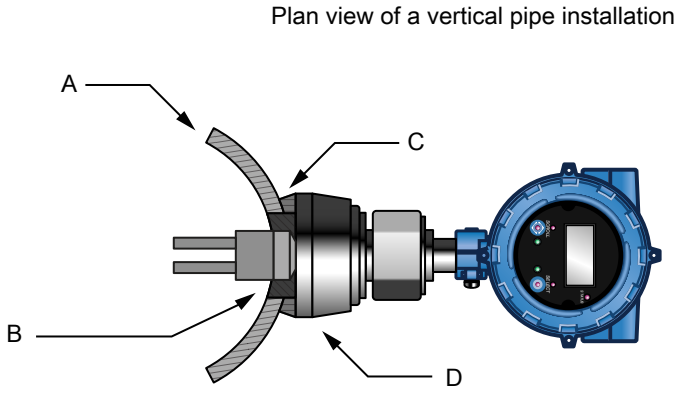
Procedure

See *Figure 2-2* for information on installing the meter (with a weldolet fitting) in a free-stream application.

Important

You must always install the meter horizontally and oriented to allow flow in the gap between the tines, irrespective of the pipeline orientation (horizontal or vertical). This position helps to prevent the trapping of bubbles or solids on the meter – allowing the solids to sink and the bubbles to rise.

Figure 2-2: Free-stream (weldolet fitting) meter installation



A. 4-inch pipe for horizontal installations; 6-inch (152 mm) pipe for vertical installations
B. 2.1 in (52.5 mm) meter opening in pipeline
C. Weld
D. Free-stream weldolet (purchased to fit pipe diameter)

2.3 Mount with a T-piece (flanged fitting)

Prerequisites

- T-piece (flanged) installations are recommended for processes with the following conditions:

Flow	0.3 to 0.5 m/s (at the pipe wall)
Viscosity	0.5 to 100 cP
Temperature	- -50 °C to 200 °C (–58 °F to 392 °F) - -40 °C to 200 °C (-40 °F to 392 °F) in hazardous areas

Note

- Flow velocity at the pipe wall and fluid viscosity must be within the limits shown to ensure that the fluid within the pocket is refreshed in a timely manner. This installation will not respond as rapidly as the free-stream installation to step changes in viscosity.
- The thermal mass of the flanges may affect the response time of the meter to temperature changes.

- Attach the PFA ring and circlip to the underside of the meter flange before installing the meter in your application (see *Section 2.7*).

Procedure

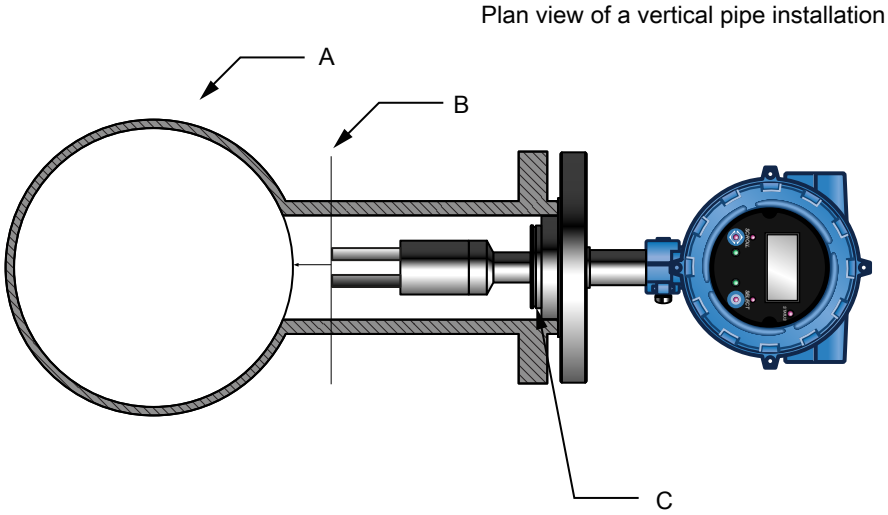
See *Figure 2-3* for information on installing the meter (with a flanged fitting) in a T-piece.

Size the T-piece so that the meter tines are retracted 1 in (25 mm) from the main pipe wall. For higher flow rates, increase this by 0.4 in (10 mm) for every 1 m/s increase in the main flow rate.

Important

You must always install the meter horizontally and oriented to allow flow in the gap between the tines, irrespective of the pipeline orientation (horizontal or vertical). This position helps to prevent the trapping of bubbles or solids on the meter – allowing the solids to sink and the bubbles to rise.

Figure 2-3: T-piece (flanged fitting) meter installation



A. 4-inch pipe or larger for horizontal or vertical installations
B. Distance of meter tines from main pipe wall is determined by the maximum flow rate of the process.
C. PFA ring and circlip

2.4 Mount with a flow-through chamber

Flow-through chambers are manufactured by Micro Motion, and are available with either weld-prepared ends or with flange or compression fittings for connection into the process pipelines. They are available with 1- inch NB, 2-inch NB, or 3-inch NB inlet and outlet pipes.

Important

The length of the inlet and outlet pipes must not be altered, otherwise the temperature response and stability of the fitting may be adversely affected.

Prerequisites

Installations in flow-through chambers are recommended for processes with the following conditions:

Flow	Constant • 10–30 l/min for 2-inch Schedule 40 calibration bore section • 5–300 l/min for 3-inch Schedule 80 calibration bore section
Viscosity	0.5 to 1000 cP
Temperature	–50 °C to 200 °C (–58 °F to 392 °F)
	–40 °C to 200 °C (–40 °F to 392 °F) in hazardous areas
Pressure	70 bar @ 204 °C, subject to process connections

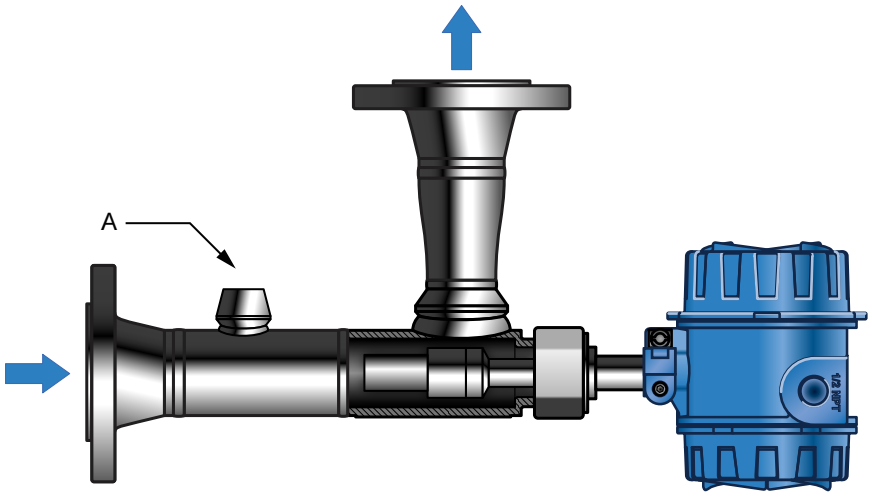
Important

- Flow velocity at the pipe wall and fluid viscosity must be within the limits shown to ensure that the fluid within the pocket is refreshed in a timely manner. This installation will not respond as rapidly as the free-stream installation to step changes in viscosity.
- The thermal mass of the flanges may affect the response time of the meter to temperature changes.

Procedure

See *Figure 2-4* for an example installation of a meter in a flow-through chamber.

Figure 2-4: Flow-through chamber meter installation



A. Optional temperature port

Note

- *This flow-through chamber is a direct-insertion type chamber that does not have a thermowell and uses a ¾-inch Swagelok connection.*
- *The three compression fittings on the flow pockets (½-inch drain, ¾-inch temperature probe, and 1-½-inch mounting nut for the meter) are rated to above the working pressure of the flow pocket. The fittings may be Swagelok or Parker.*

2.5 Mount in an open tank (long-stem meter)

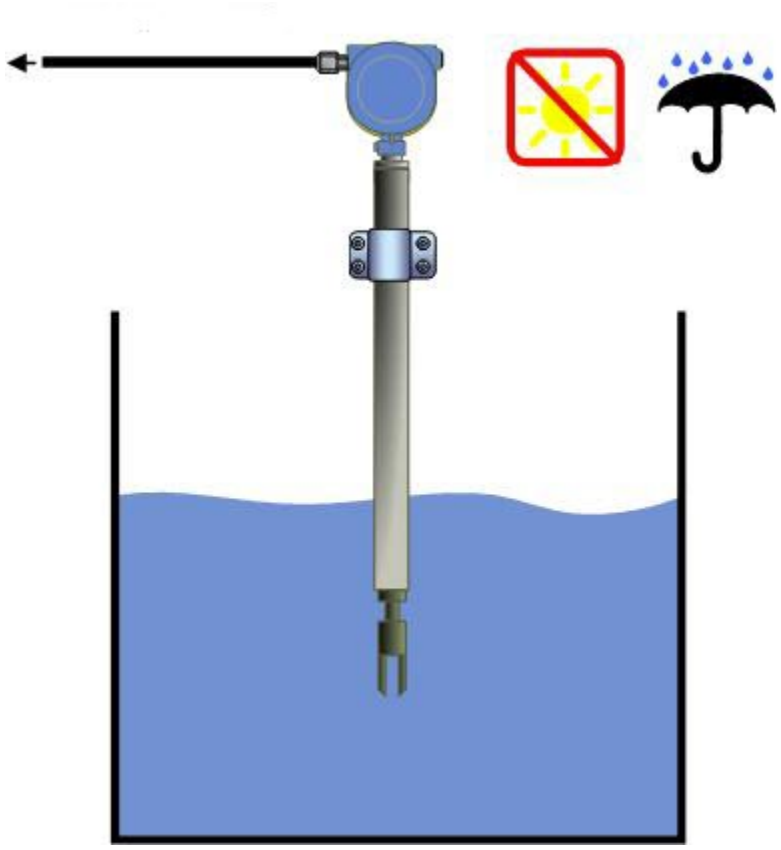
⚠ CAUTION!

Only the safe area version of the long-stem meter can be mounted in an open tank.

Procedure

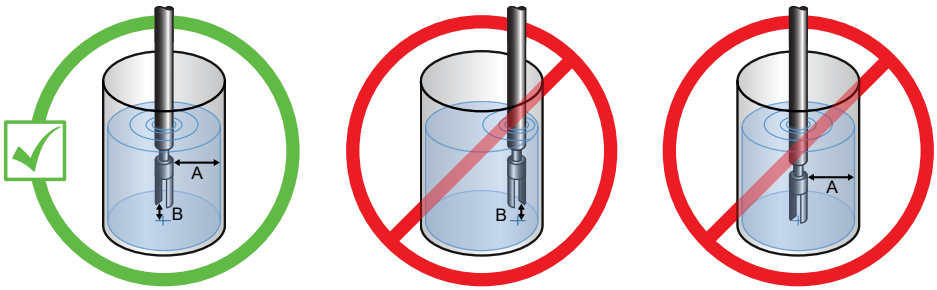
1. Clamp the long-stem meter to a structure, positioning the clamp to determine the insertion depth of the meter.

Figure 2-5: Open-tank meter installation (long stem)



2. Confirm the meter tines are away from the tank wall.

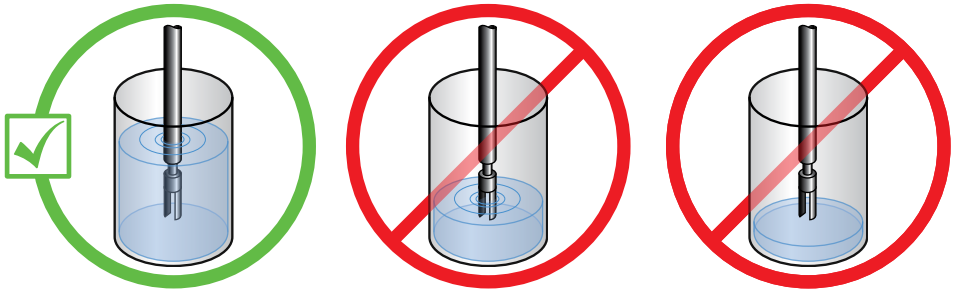
Figure 2-6: Meter placement (away from tank wall)



A. 50 mm
B. 200 mm

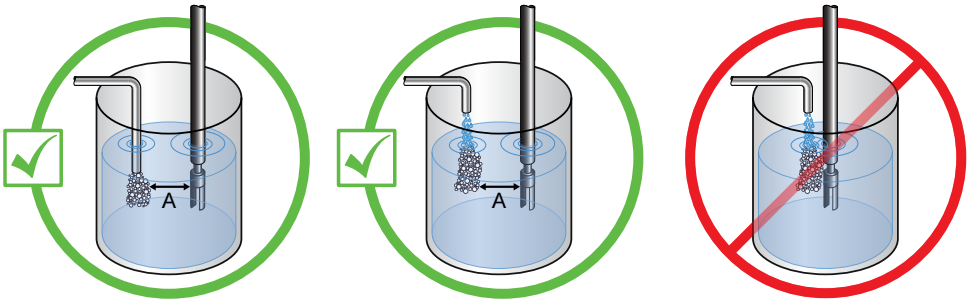
3. Confirm the meter tines are immersed in fluid.

Figure 2-7: Meter placement (immersed in fluid)



4. Confirm the meter tines are placed away from objects and disturbed flow.

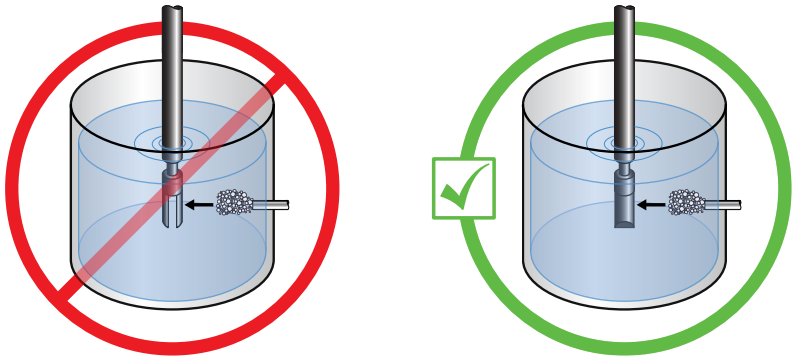
Figure 2-8: Meter placement (distance from objects and disturbed flow)



A. 200 mm

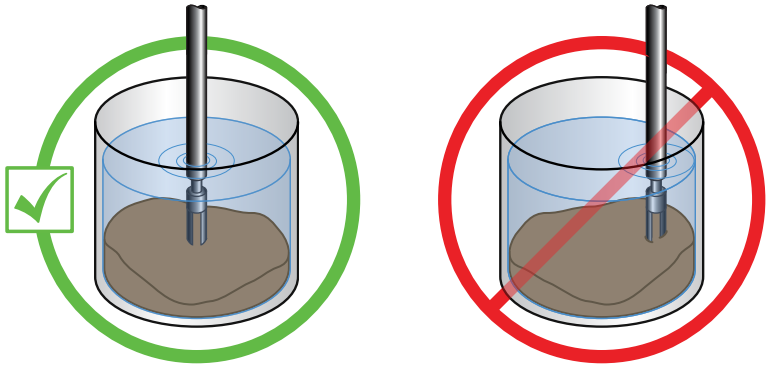
5. If flow exists, confirm the meter tines are aligned so that the flow is directed towards or through the gap between the tines.

Figure 2-9: Meter placement (flow direction through tine gap)



6. Confirm the meter tines are kept away from deposit buildup.

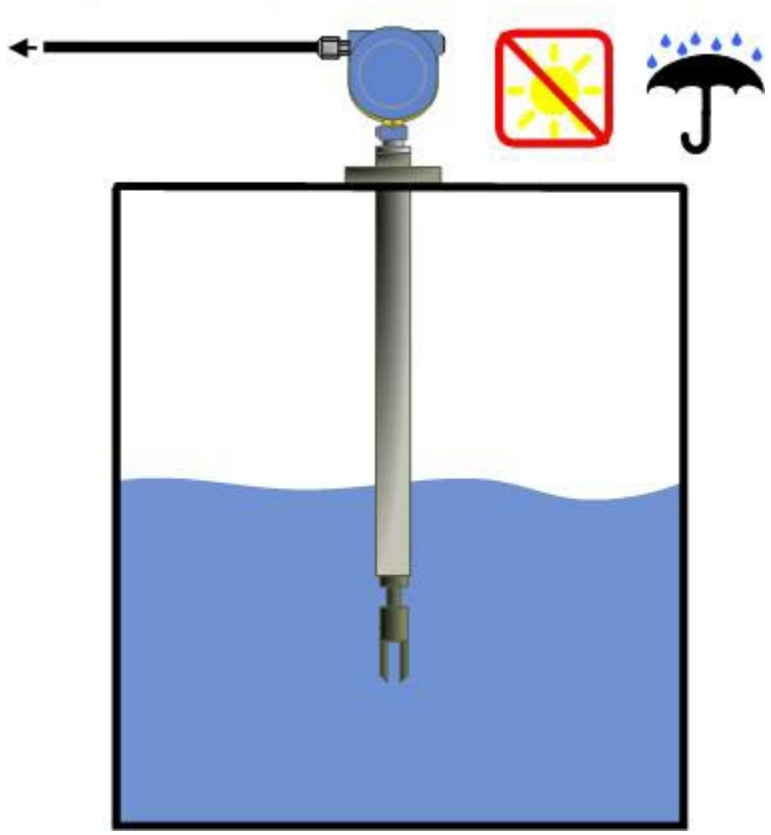
Figure 2-10: Meter placement (away from deposit buildup)



2.6 Mount in a closed tank (long-stem meter)

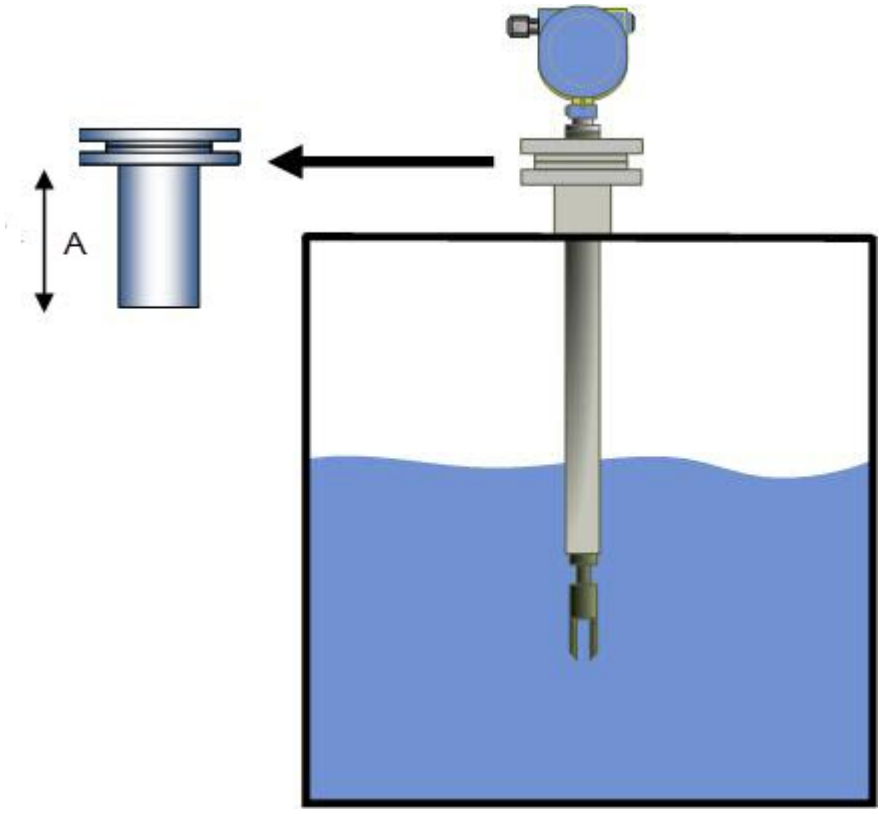
1. Attach the long-stem meter using the fitted flange attachment (shipped with the product).

Figure 2-11: Closed-tank installation (fitted flange attachment)



2. (Optional) To vary the insertion depth of the meter, mount the meter on a standoff section that attaches to the flange (not provided).

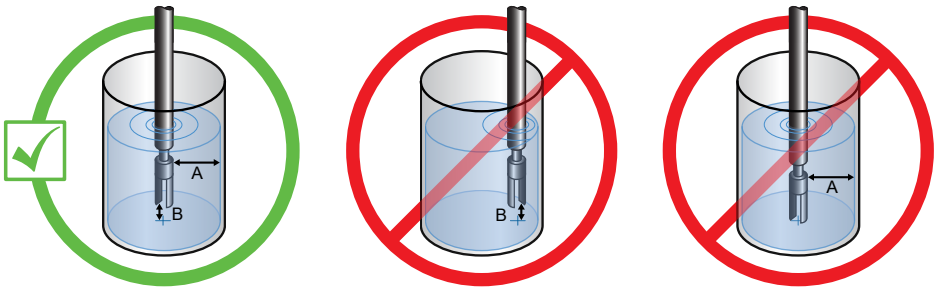
Figure 2-12: Closed-tank installation (with standoff)



A. Standoff height can vary (provided by customer)

3. Confirm the meter tines are away from the tank wall.

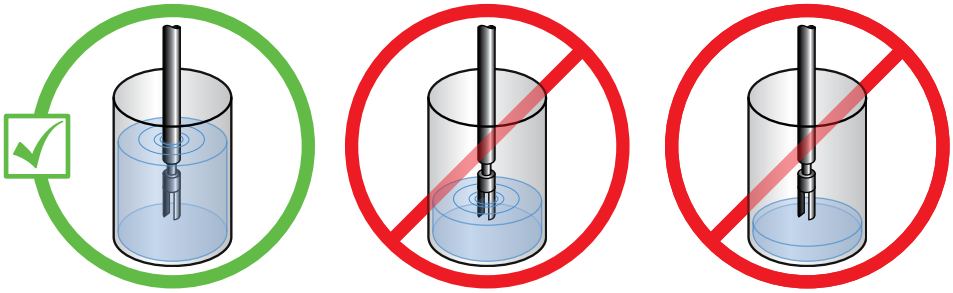
Figure 2-13: Meter placement (away from tank wall)



A. 50 mm
B. 200 mm

4. Confirm the meter tines are immersed in fluid.

Figure 2-14: Meter placement (immersed in fluid)



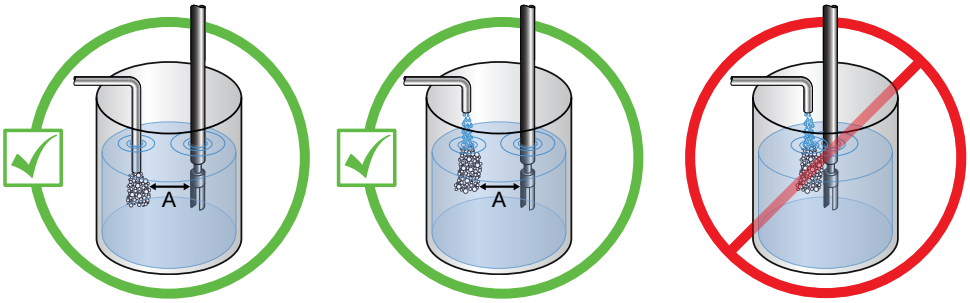
5. Confirm the meter placement has allowed for the flexing of the tank lid to prevent the meter from being pushed towards a tank wall or into the path of disturbed flow.

Figure 2-15: Meter placement (allowance for tank lid flexing)

A. 200 mm

6. Confirm the meter tines are placed away from objects and disturbed flow.

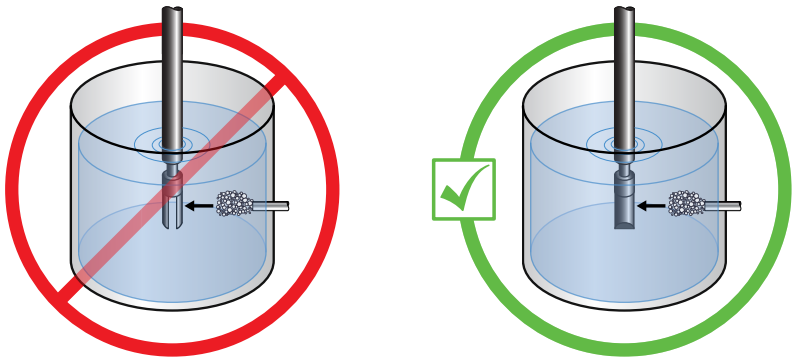
Figure 2-16: Meter placement (distance from objects and disturbed flow)



A. 200 mm

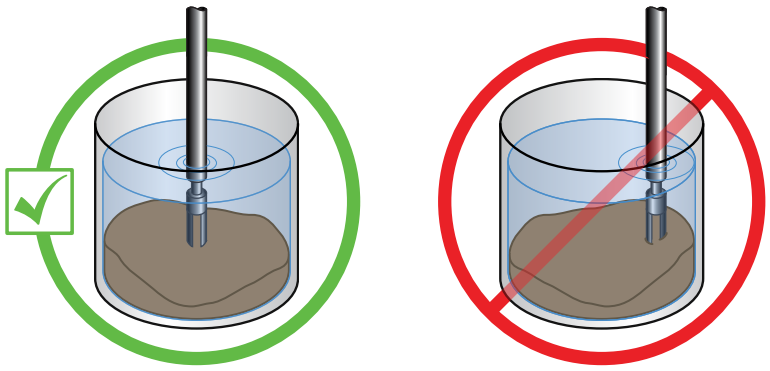
7. If flow exists, confirm the meter tines are aligned so that the flow is directed towards or through the gap between the tines.

Figure 2-17: Meter placement (flow direction through tine gap)



8. Confirm the meter tines are kept away from deposit buildup.

Figure 2-18: Meter placement (away from deposit buildup)



2.7 Attach the PFA ring and circlip

You attach the PFA ring (and circlip) around the boss on the underside of the meter flange to center the meter tines within a 2-inch Schedule 40 or 80 pipe. The circlip holds the ring in place.

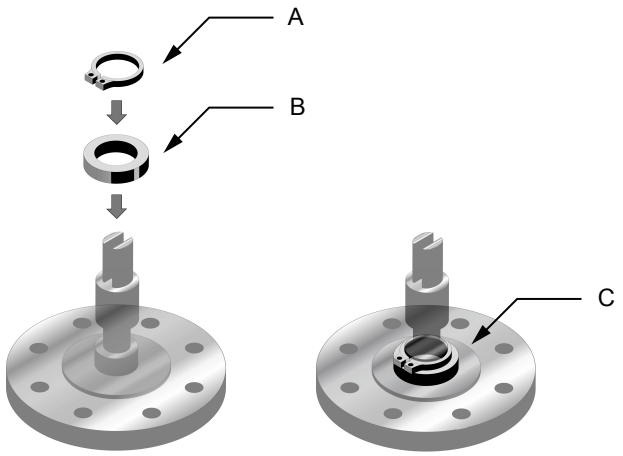
Note

If you are using the Zirconium version of the meter, a self-locking PFA ring is provided and does not require a circlip to keep it in place.

Procedure

See *Figure 2-19* for information on attaching the PFA ring and circlip to the meter.

Figure 2-19: Attaching a PFA ring and circlip



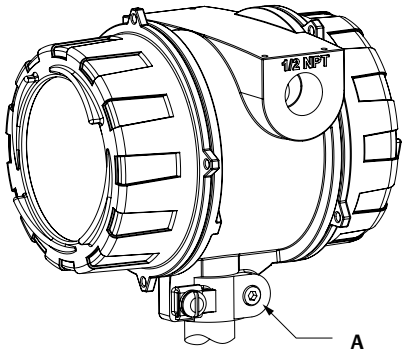
A. Circlip (not provided with self-locking PFA rings)
B. PFA ring
C. PFA ring and circlip attached

2.8 Rotate the electronics on the meter (optional)

You can rotate the transmitter on the meter up to 90°.

1. Using a 4 mm hex key, loosen the cap screw that holds the transmitter in place.

Figure 2-20: Component to secure transmitter in place



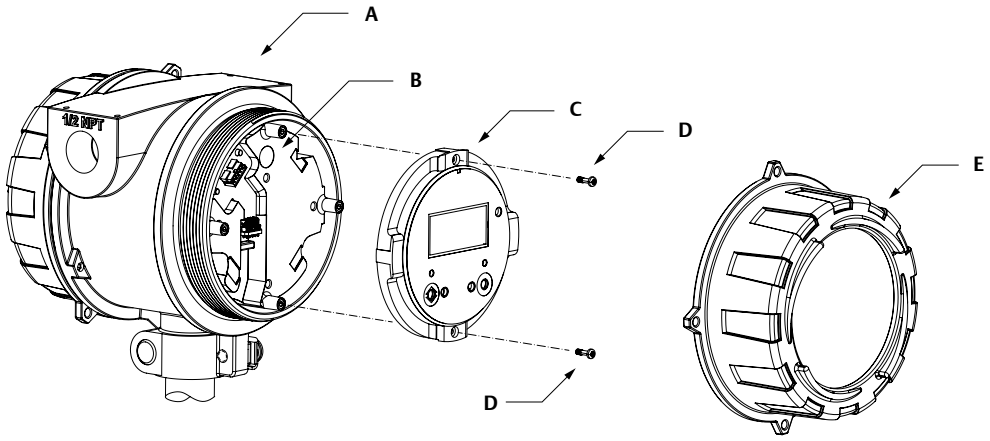
A. M5 socket-head cap screw

2. Rotate the transmitter clockwise to the desired orientation up to 90°.
3. Secure the cap screw in place and tighten to 60 lb·in (6.8 N·m).

2.9 Rotate the display on the transmitter (optional)

The display on the transmitter electronics module can be rotated 90° or 180° from the original position.

Figure 2-21: Display components



A. Transmitter housing
B. Sub-bezel
C. Display module
D. Display screws
E. Display cover

Procedure

1. Power down the meter.
2. Turn the display cover counterclockwise to remove it from the main enclosure.
3. Carefully loosen (and remove if necessary) the semi-captive display screws while holding the display module in place.
4. Carefully pull the display module out of the main enclosure until the sub-bezel pin terminals are disengaged from the display module.

Note
If the display pins come out of the board stack with the display module, remove the pins and reinstall them.

5. Rotate the display module to the desired position.
6. Insert the sub-bezel pin terminals into the display module pin holes to secure the display in its new position.

7. If you have removed the display screws, line them up with the matching holes on the sub-bezel, then reinsert and tighten them.
8. Place the display cover onto the main enclosure.
9. Turn the display cover clockwise until it is snug.
10. Power up the meter.

3 Wiring

Topics covered in this chapter:

3.1 Available output terminals and wiring requirements

Three pairs of wiring terminals are available for transmitter outputs. These outputs vary depending on your transmitter output option ordered. The Analog (mA), Time Period Signal (TPS), and Discrete (DO) outputs require external power, and must be connected to an independent 24 VDC power supply.

For meters connecting to a remote-mount 2700 FOUNDATION fieldbus™ transmitter, you must wire the meter to the remote-mount 2700 transmitter using a 4-wire cable connection. See the processor wiring content in this manual for information on how to wire the meter. Refer to the transmitter installation manual for information on wiring the remote-mount 2700 FOUNDATION fieldbus™ transmitter.

The screw connectors for each output terminal accept a maximum wire size of 14 AWG (2.5 mm^2).

Important

- Output wiring requirements depend on whether the meter will be installed in a safe area or a hazardous area. It is your responsibility to verify that the specific installation meets the local and national safety requirements and electrical codes.
- If you will configure the meter to poll an external temperature or pressure device, you must wire the mA output to support HART communications. You may use either HART/analog single-loop wiring or HART multi-drop wiring.

Table 3-1: Available transmitter outputs

Transmitter version	Output channels		
	A	B	C
Analog	4–20 mA + HART	4–20 mA	Modbus/RS-485
Discrete	4–20 mA + HART	Discrete output	Modbus/RS-485
Processor for remote-mount 2700 FOUNDATION fieldbus™	Disabled	Disabled	Modbus/RS-485

3.2 Explosion-proof/flameproof or non-hazardous output wiring

3.2.1 Wire the Analog outputs version in an explosion-proof/ flameproof or non-hazardous area

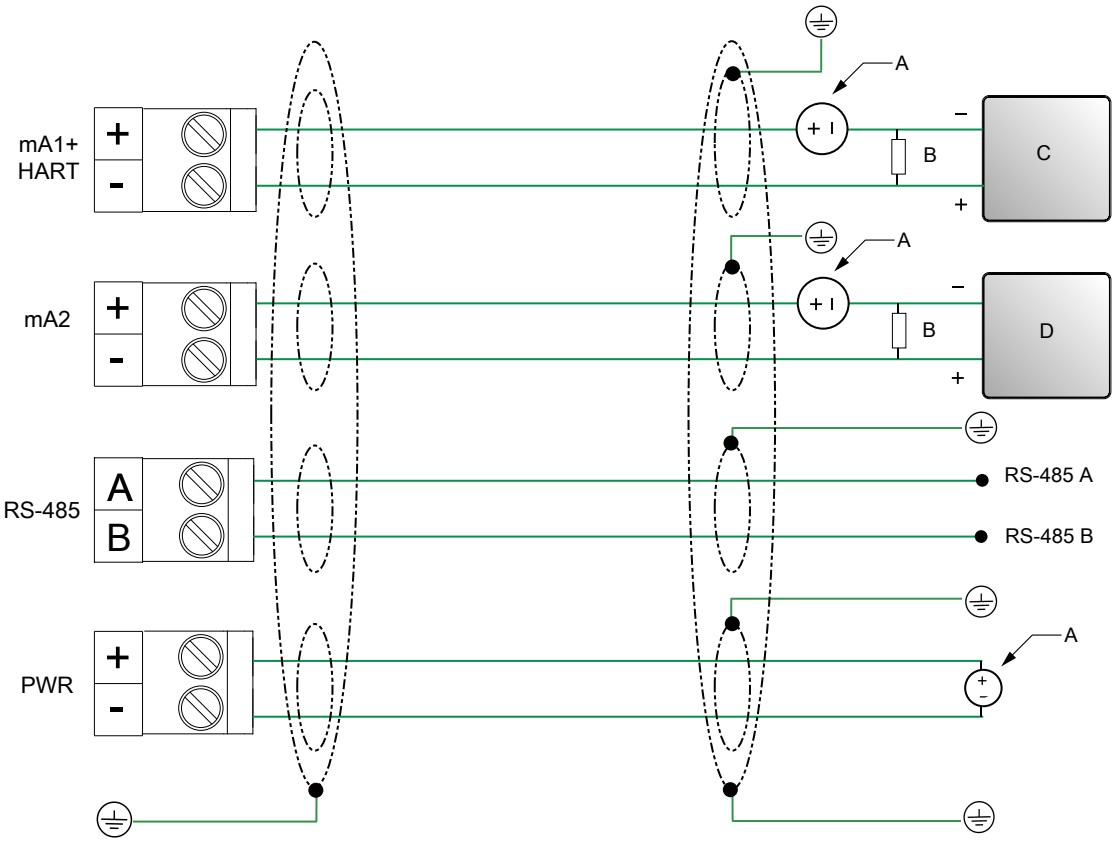
⚠ CAUTION!

Meter installation and wiring should be performed by suitably trained personnel only in accordance with the applicable code of practice.

Procedure

Wire to the appropriate output terminal and pins (see *Figure 3-1*).

Figure 3-1: Wiring the Analog outputs version



A. 24 VDC
B. R_{load} (250 Ω resistance)
C. HART-compatible host or controller; and/or signal device
D. Signal device

Note

For operating the milliamp outputs with a 24V supply, a maximum total loop resistance of 657 Ω is allowed.

⚠ CAUTION!

- ***To meet the EC Directive for EMC (Electromagnetic Compatibility), it is recommended that the meter be connected using a suitable instrumentation cable. The instrumentation cable should have individual screen(s), foil or braid over each twisted pair and an overall screen to cover all cores. Where permissible, the overall screen should be connected to earth at both ends (360° bonded at both ends). The inner individual screen(s) should be connected at only one end, the controller end.***
- ***Metal cable glands should be used where the cables enter the meter amplifier box. Unused cable ports should be fitted with metal blanking plugs.***

3.2.2 Wire the Discrete output version in an explosion-proof/ flameproof or non-hazardous area

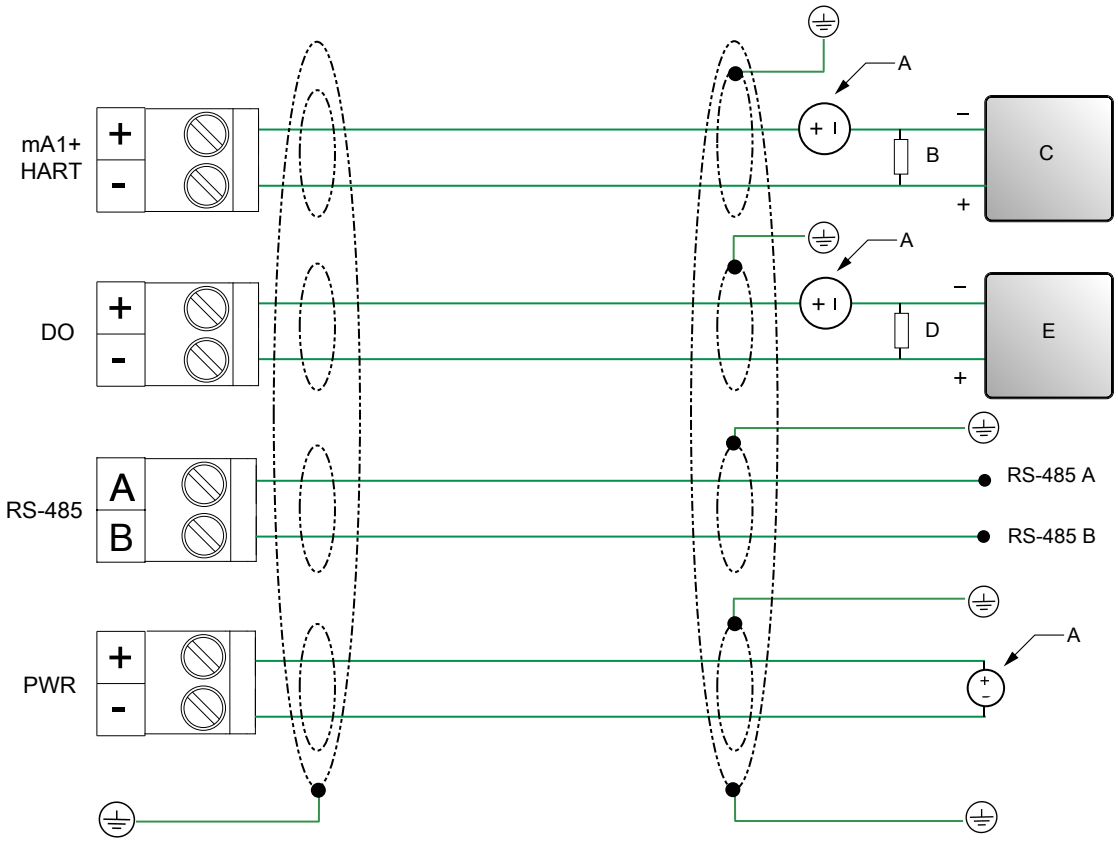
⚠ CAUTION!

Meter installation and wiring should be performed by suitably trained personnel only in accordance with the applicable code of practice.

Procedure

Wire to the appropriate output terminal and pins (see *Figure 3-2*).

Figure 3-2: Wiring the Discrete output version



A. *24 VDC*
B. *R_{load} (250 Ω resistance)*
C. *HART-compatible host or controller; and/or signal device*
D. *R_{load} (500 Ω resistance recommended)*
E. *Discrete input device*

Note

- *For operating the milliamp output with a 24V supply, a maximum total loop resistance of 657 Ω is allowed.*
- *When operating the Discrete output with a 24 VDC power supply, a maximum total loop resistance of 1300 Ω is allowed.*

⚠ CAUTION!

- ***To meet the EC Directive for EMC (Electromagnetic Compatibility), it is recommended that the meter be connected using a suitable instrumentation cable. The instrumentation cable should have individual screen(s), foil or braid over each twisted pair and an overall screen to cover all cores. Where permissible, the overall screen should be connected to earth at both ends (360° bonded at both ends). The inner individual screen(s) should be connected at only one end, the controller end.***

- ***Metal cable glands should be used where the cables enter the meter amplifier box. Unused cable ports should be fitted with metal blanking plugs.***

3.3 Processor wiring for remote-mount 2700 FOUNDATION fieldbus™ option

3.3.1 RS-485 entity parameters for the remote-mount 2700 FOUNDATION fieldbus™ option

⚠ DANGER!

Hazardous voltage can cause severe injury or death. To reduce the risk of hazardous voltage, shut off power before wiring the meter.

⚠ DANGER!

Improper wiring in a hazardous environment can cause an explosion. Install the meter only in an area that complies with the hazardous classification tag on the meter.

Table 3-2: RS-485 output and cable entity parameters

Cable parameters for intrinsically safe circuit (linear)	
Voltage (U_i)	17.22 VDC
Current (I_i)	484 mA
Maximum capacitance (C_i)	1 nF
Maximum inductance (L_i)	Negligible
Cable parameters for Ex ib IIB, Ex ib IIC	
Voltage (U_o)	9.51 VDC
Current (instantaneous) (I_o)	480 mA
Current (steady state) (I)	106 mA
Power (P_o)	786 mW
Internal resistance (R_i)	19.8 Ω
Cable parameters for Group IIC	
Maximum external capacitance (C_o)	85 nF
Maximum external inductance (L_o)	25 µH
Maximum external inductance/resistance ratio (L_o/R_o)	31.1 µH/Ω
Cable parameters for Group IIB	
Maximum external capacitance (C_o)	660 nF

Table 3-2: RS-485 output and cable entity parameters *(continued)*

Maximum external inductance (L_o)	260 µH
Maximum external inductance/resistance ratio (L_o/R_o)	124.4 µH/Ω

3.3.2 Prepare the 4-wire cable

Important

For user-supplied cable glands, the gland must be capable of terminating the drain wires.

Note

If you are installing unshielded cable in continuous metallic conduit with 360º termination shielding, you only need to prepare the cable – you do not need to perform the shielding procedure.

Figure 3-3: 4-wire cable preparation

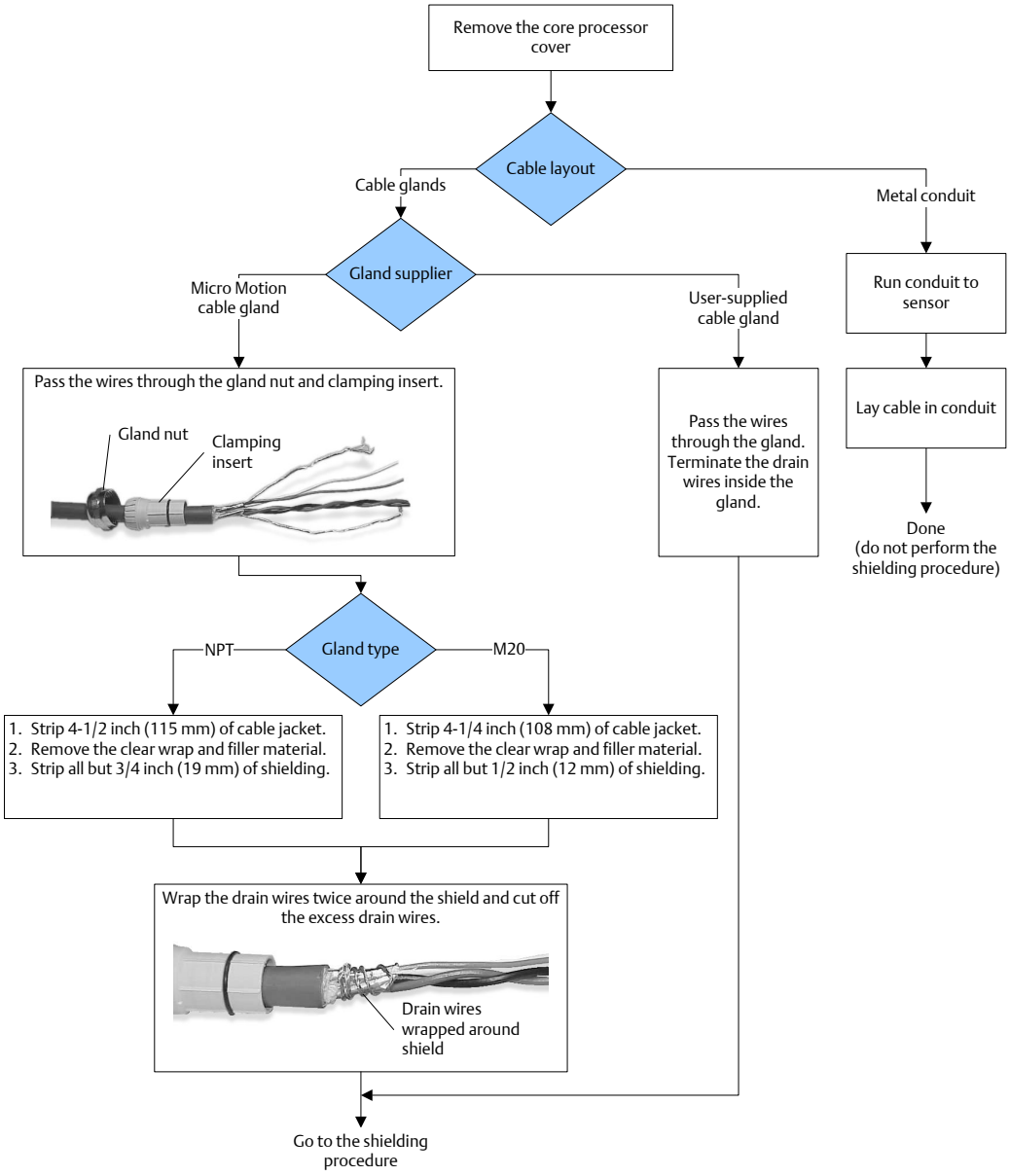
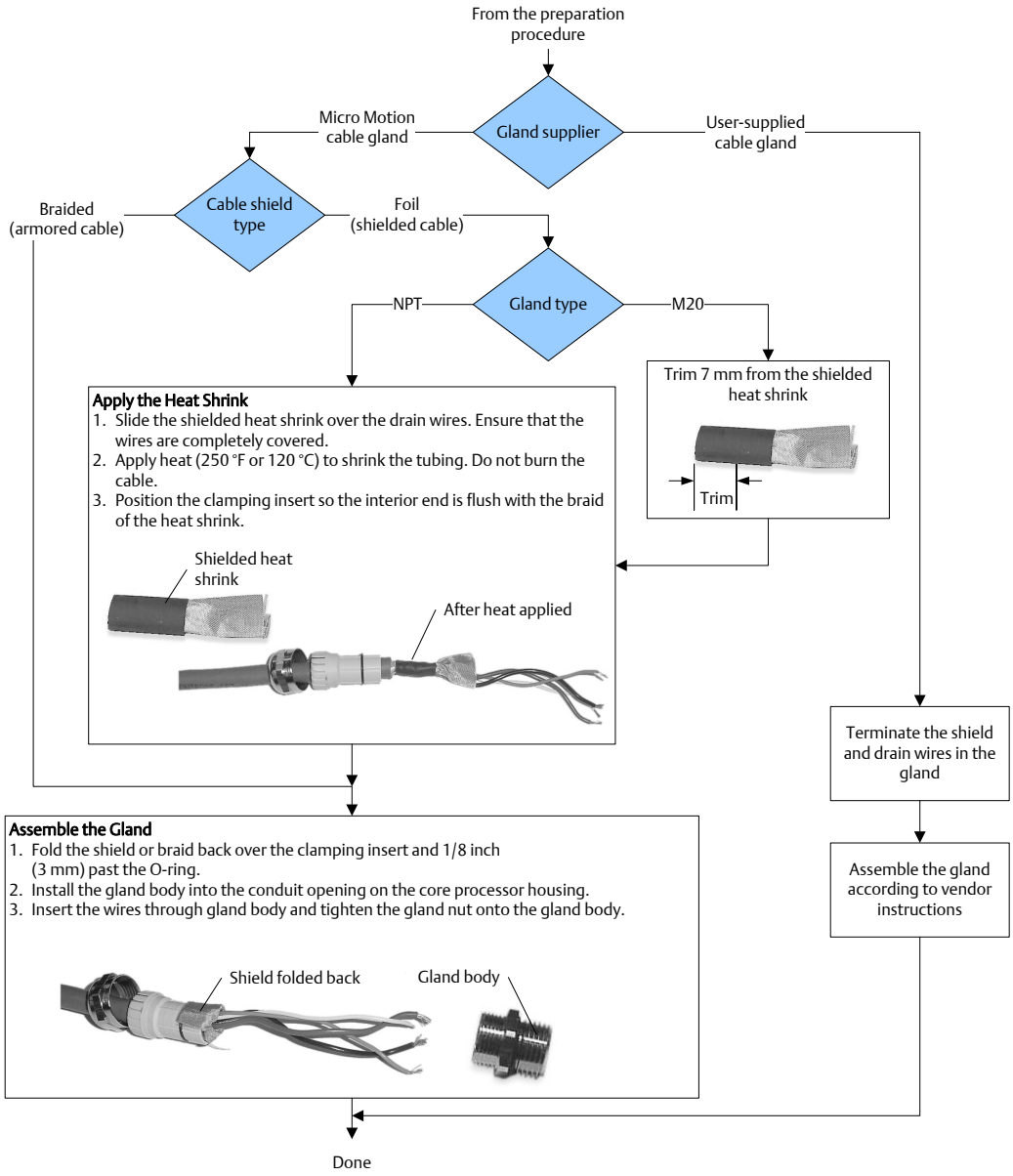


Figure 3-4: 4-wire cable shielding



4-wire cable types and usage

Micro Motion offers two types of 4-wire cable: shielded and armored. Both types contain shield drain wires.

The 4-wire cable supplied by Micro Motion consists of one pair of red and black 18 AWG (0.75 mm^2) wires for the VDC connection, and one pair of white and green 22 AWG (0.35 mm^2) wires for the RS-485 connection.

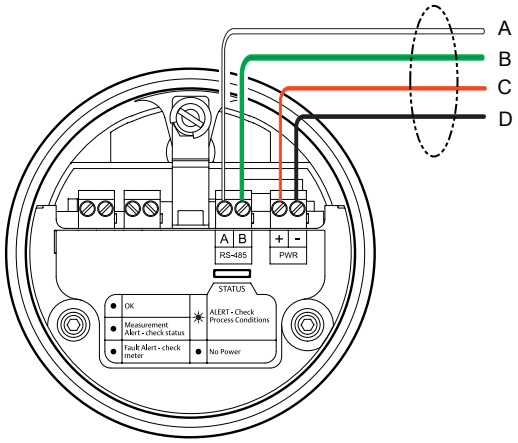
User-supplied 4-wire cable must meet the following requirements:

- Twisted pair construction.
- Applicable hazardous area requirements, if the core processor is installed in a hazardous area.
- Wire gauge appropriate for the cable length between the core processor and the transmitter.
- Wire gauge of 22 AWG or larger, with a maximum cable length of 1000 feet.

3.3.3 Processor wiring for the remote-mount 2700 FOUNDATION fieldbus™ option

The following figure illustrates how to connect the individual wires of a 4-wire cable to the processor terminals. For detailed information on mounting and wiring to the remote-mount 2700 FOUNDATION fieldbus transmitter, see the transmitter installation manual.

Figure 3-5: Processor (Modbus/RS-485) connections to the remote-mount 2700 FF transmitter



A. White wire to RS-485/A terminal
B. Green wire to RS-485/B terminal
C. Red wire to Power supply (+) terminal
D. Black wire to Power supply (–) terminal

Important

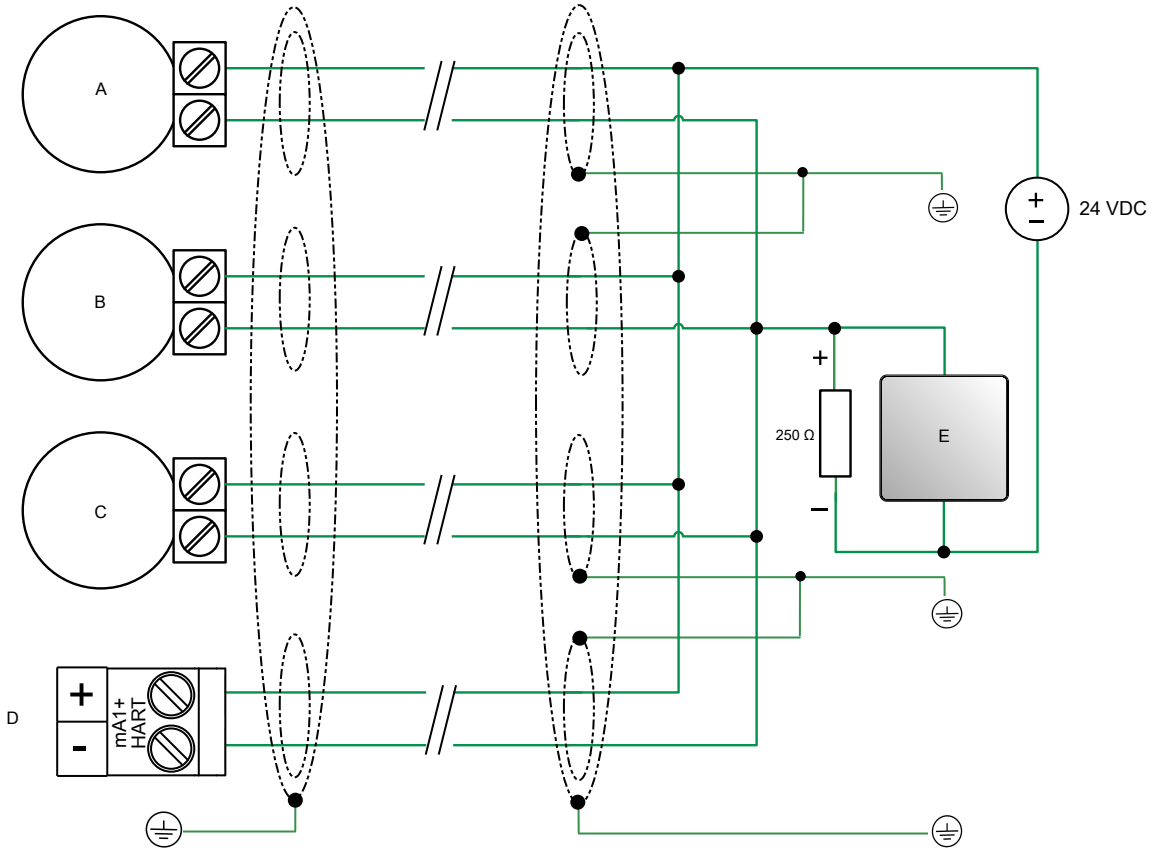
- *To meet the EC Directive for EMC (Electromagnetic Compatibility), it is recommended that the meter be connected using a suitable instrumentation cable. The instrumentation cable should have individual screen(s), foil or braid over each twisted pair and an overall screen to cover all cores. Where permissible, the overall screen should be connected to earth at both ends (360° bonded at both ends). The inner individual screen(s) should be connected at only one end, the controller end.*
- *Metal cable glands should be used where the cables enter the meter amplifier box. Unused cable ports should be fitted with metal blanking plugs.*

3.4 Wiring to external devices (HART multidrop)

You can wire up to three external HART devices with the meter. The following information provides wiring diagrams for making those connections in safe and hazardous environments.

3.4.1 Wire external HART devices in an explosion-proof/ flameproof or non-hazardous area

Figure 3-6: Wiring external devices in an explosion-proof/flameproof or non-hazardous area



A. HART Device 1
B. HART Device 2
C. HART Device 3
D. Meter (mA+/HART output)
E. HART/Field Communicator

⚠ *CAUTION!*

- ***To meet the EC Directive for EMC (Electromagnetic Compatibility), it is recommended that the meter be connected using a suitable instrumentation cable. The instrumentation cable should have individual screen(s), foil or braid over each twisted pair and an overall screen to cover all cores. Where permissible, the overall screen should be connected to earth at both ends (360° bonded at both ends). The inner individual screen(s) should be connected at only one end, the controller end.***
- ***Metal cable glands should be used where the cables enter the meter amplifier box. Unused cable ports should be fitted with metal blanking plugs.***

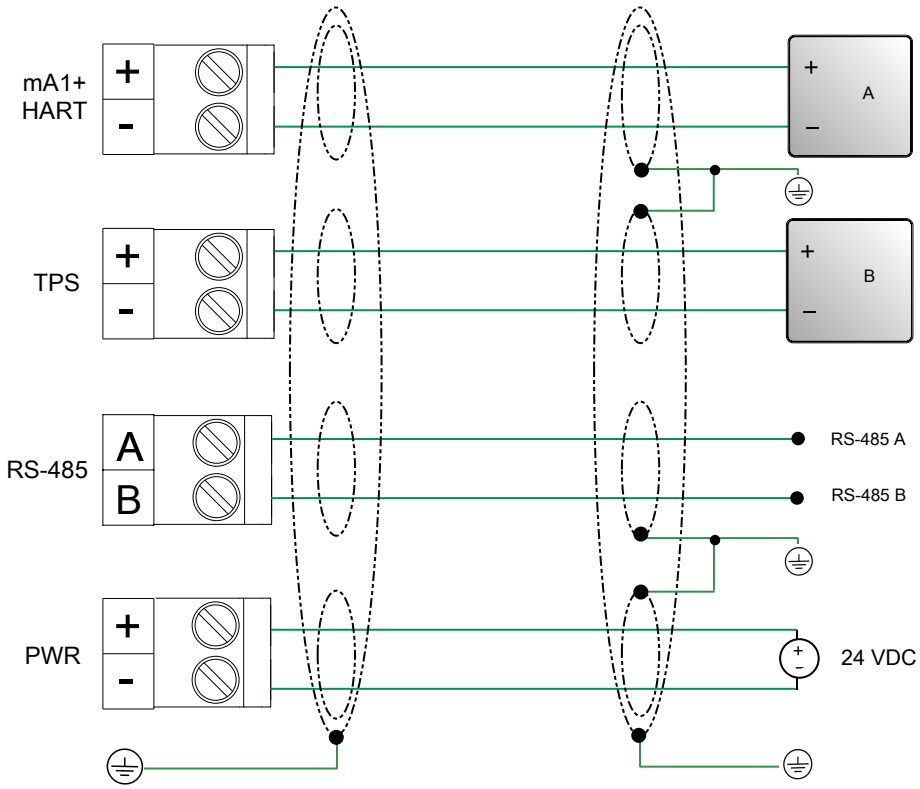
3.5 Wiring to signal converters and/or flow computers

For meters with a Time Period Signal (TPS) output, you can wire the meter to an signal converter or flow computer directly. The following information provides wiring diagrams for making those connections in safe and hazardous environments.

When wiring the meter to an active HART host or signal converter/flow computer, you are not required to provide external power to the output connections. These active devices provide the 24 VDC necessary for these connections.

3.5.1 Wire to a signal converter/flow computer in an explosion-proof/flameproof or non-hazardous area

Figure 3-7: Wiring to a signal converter/flow computer in an explosion-proof/ flameproof or non-hazardous area



A. Active HART host

B. Active signal converter/flow computer

⚠ CAUTION!

- ***To meet the EC Directive for EMC (Electromagnetic Compatibility), it is recommended that the meter be connected using a suitable instrumentation cable. The instrumentation cable should have individual screen(s), foil or braid over each twisted pair and an overall screen to cover all cores. Where permissible, the overall screen should be connected to earth at both ends (360° bonded at both ends). The inner individual screen(s) should be connected at only one end, the controller end.***
- ***Metal cable glands should be used where the cables enter the meter amplifier box. Unused cable ports should be fitted with metal blanking plugs.***

4 Grounding

The meter must be grounded according to the standards that are applicable at the site. The customer is responsible for knowing and complying with all applicable standards.

Prerequisites

Micro Motion suggests the following guides for grounding practices:

- In Europe, EN 60079-14 is applicable to most installations, in particular Sections 12.2.2.3 and 12.2.2.4.
- In the U.S.A. and Canada, ISA 12.06.01 Part 1 provides examples with associated applications and requirements.
- For IECEx installations, IEC 60079-14 is applicable.

If no external standards are applicable, follow these guidelines to ground the meter:

- Use copper wire, 18 AWG (0.75 mm^2) or larger wire size.
- Keep all ground leads as short as possible, less than 1 Ω impedance.
- Connect ground leads directly to earth, or follow plant standards.

⚠ CAUTION!

Ground the meter to earth, or follow ground network requirements for the facility. Improper grounding can cause measurement error.

Procedure

Check the joints in the pipeline or tank installation.

- If the joints in the pipeline or tank are ground-bonded, the meter is automatically grounded and no further action is necessary (unless required by local code).
- If the joints in the pipeline or tank are not grounded, connect a ground wire to the grounding screw located on the meter electronics.

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Micro Motion Inc. USA
Worldwide Headquarters
7070 Winchester Circle
Boulder, Colorado 80301
T +1 303-527-5200
T +1 800-522-6277
F +1 303-530-8459
www.micromotion.com

Micro Motion Europe
Emerson Process Management
Neonstraat 1
6718 WX Ede
The Netherlands
T +31 (0) 318 495 555
F +31 (0) 318 495 556
www.micromotion.nl

Micro Motion Asia
Emerson Process Management
1 Pandan Crescent
Singapore 128461
Republic of Singapore
T +65 6777-8211
F +65 6770-8003

Micro Motion United Kingdom
Emerson Process Management Limited
Horsfield Way
Bredbury Industrial Estate
Stockport SK6 2SU U.K.
T +44 0870 240 1978
F +44 0800 966 181

Micro Motion Japan
Emerson Process Management
1-2-5, Higashi Shinagawa
Shinagawa-ku
Tokyo 140-0002 Japan
T +81 3 5769-6803
F +81 3 5769-6844

Micro Motion®

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Process Management